

Claims

What is claimed is:

1. A system for monitoring a patient, comprising:
vibration sensing means for collecting tracheal vibration information from the patient;
and
position sensing means that changes state depending upon its orientation with respect to the earth's gravity, at least a portion of which is substantially adjacent to a portion of the vibration sensing means.
2. The system of claim 1, wherein the vibration sensing means comprises a microphone.
3. The system of claim 1, wherein the position sensing means comprises an accelerometer.
4. The system of claim 1, wherein the position sensing means comprises a gravity sensing switch having at least one axis of orientation with respect to gravity such that the switch occupies different states depending upon which end of the axis is closer to the source of gravity.
5. The system of claim 4, wherein the gravity sensing switch further comprises a tilt switch having:
a body containing a cavity;
a plurality of contact point pairs within the cavity;
an electrically conductive material that is able to move within the cavity, such that as the orientation of the body with respect to gravity changes different pairs of contact points are connected, thus providing a signal indicative of the tilt switch's orientation with respect to gravity.
6. The system of claim 4, wherein the position sensing means comprises:

a first gravity sensing switch having a first axis of orientation with respect to gravity;
and

a second gravity sensing switch having a second axis of orientation with respect to
gravity which can be superpositioned at an angle to the first axis.

7. The system of claim 6, further comprising a means for coupling the system to at
least a portion of the patient's body, such that the position sensing means provides information
indicative of changes in orientation of the portion of the patient's body to which the system is
coupled.

8. The system of claim 7, wherein a plane containing the superposition of the two
axes is at an angle to the portion of the patient's body such that the position sensing means
provides information indicative of which of two or more positions the portion of the patient's
body is in with respect to the earth's gravity.

9. The system of claim 8, wherein the portion of the patient's body to which the
housing is coupled, and to which the plane is at an angle, is an axial portion.

10. The system of claim 9, wherein the angle between the two superpositioned axes is
substantially a right angle.

11. The system of claim 10, wherein the angle between the plane and the axial portion
of the patient's body is substantially a right angle.

12. The system of claim 1, further comprising means for simultaneously coupling at
least a portion of the vibration sensing means and a portion of the position sensing means to a
portion of the patient's body, such that the position sensing means tracks changes in orientation
of the portion of the patient's body to which the system is coupled.

13. The system of claim 12, wherein the means for simultaneously coupling further comprises a housing containing at least a portion of the vibration sensing means and a portion of the position sensing means.

14. The system of claim 13, wherein the means for simultaneously coupling further comprises an adhesive material coupled to a portion of the housing.

15. The system of claim 9, wherein the angle between the superpositioned axes of the two tilt switches, and the angle between the plane and the axial portion of the patient's body, are such that the tilt switches indicate which of two or more positions the axial portion of the patient's body is in, one of which positions is substantially supine and one of which positions is not substantially supine.

16. The system of claim 9, wherein the angle between the superpositioned axes of the two tilt switches, and the angle between the plane and axial portion of the patient's body, are such that the sensor indicates which of four or more positions the axial portions of the patient's body is in, one of which positions is substantially supine, one of which positions is substantially prone, one of which positions is substantially left lateral decubitus, and one of which positions is substantially right lateral decubitus.

17. The system of claim 4, further comprising means for coupling the system to an axial portion of the patient's body, with the axis of the tilt switch at an angle to the axial portion such that the tilt switch provides information indicative of which of two or more positions the axial portion of the patient's body is in, one of which positions is substantially supine and one of which positions is not substantially supine.

18. The system of claim 1, further comprising a recording means for recording data representing the tracheal vibration information and data representing the state of the position sensing means over time.

19. The system of claim 13, further comprising a recording means for recording data representing the tracheal vibration information and data indicative of the orientation of the portion of the patient's body to which the system is coupled over time.

20. The system of claim 19, further comprising a sampling means capable of sampling the tracheal vibration information at a rate of at least 2 kilohertz.

21. The system of claim 19, wherein the recording means further comprises:
a memory;
a power source,
conversion means for receiving the tracheal vibration information and the information indicative of the orientation of the patient's body and converting them into digital data; and
means for writing the digital data into the memory.

22. The system of claim 21, wherein the memory further comprises a memory capable of storing 32 megabytes of data.

23. The system of claim 21, wherein an input of the conversion means is connected to an output of at least one of the sensing means by a wireless transmitter and receiver, where the transmitter is connected to an output of the sensing means and the receiver is connected to an input of the conversion means.

24. The system of claim 21, wherein an output of the conversion means is connected to an input of the memory by a wireless transmitter and receiver, where the transmitter is connected to the output of the conversion means and the receiver is connected to an input of the memory.

25. The system of claim 21, further comprising a playback means capable of substantially recreating the collected tracheal vibration information from the recording means.

26. The system of claim 25, wherein the vibration sensing means further comprises a microphone having a frequency response of at least approximately 400 to 1000 hertz, and the playback means further comprises a sound output device capable of reproducing sound in a range of at least approximately 400 to 1000 hertz, such that upon playback of the data representing the collected tracheal vibration information a listener hears at least substantially the same sound that the listener would have heard through a listening device having a frequency response of at least approximately 400 to 1000 hertz in the same position as the vibration sensing means at the time the tracheal vibration information was collected.

27. The system of claim 25, wherein the vibration sensing means further comprises a microphone having a frequency response, and the playback means further comprises a sound output device capable of reproducing sound in a range of at least approximately the same frequency response at the microphone, such that upon playback of the data representing the collected tracheal vibration information a listener hears at least substantially the same sound that the listener would have heard through a listening device having approximately the same frequency response as the microphone in the same position as the microphone at the time the tracheal vibration information was collected.

28. The system of claim 25, wherein the vibration sensing means further comprises a microphone having a frequency response containing a portion of the range of 400 to 1000 hertz, and the playback means further comprises a sound output device capable of reproducing sound in the same portion of the range of 400 to 1000 hertz, such that upon playback of the data representing the collected tracheal information a listener hears at least substantially the same sound that the listener would have heard at the time the tracheal vibration information was collected through a listening device having approximately the same frequency response as the microphone in a peri-tracheal position on the patient.

29. The system of claim 19, further comprising a computing device for reading and performing calculations on the recorded data.

30. The system of claim 13, further comprising an indicator means on the housing for showing the orientation the housing is to have when coupled to the patient's body.

31. A method for monitoring a patient, comprising:
collecting tracheal vibration information from the patient at a location on the patient's body; and

obtaining information indicative of the orientation of a portion of the patient's body with respect to gravity substantially adjacent to the location at which the tracheal vibration information is collected.

32. A method for monitoring a patient, comprising:
coupling to the patient a vibration sensing means for collecting tracheal vibration information from a patient; and
coupling to at least a portion of the patient's body, substantially adjacent to the vibration sensing means, a position sensing means that changes state depending upon its orientation with respect to gravity, such that the position sensing means provides information that is indicative of the orientation with respect to gravity of the portion of the patient's body to which it is coupled.

33. The method of claim 32, further comprising the step of recording data representing tracheal vibration information and information indicative of the orientation of the portion of the patient's body that are obtained over time.

34. The method of claim 33, wherein the step of recording data further comprises recording data from both the vibration sensing means and the position sensing means that are obtained concurrently.

35. The method of claim 33, wherein the step of recording data further comprises recording data during a period of time associated with diminished consciousness of the patient.

36. The method of claim 32, wherein the step of coupling a vibration sensing means further comprises coupling a microphone to the patient.

37. The method of claim 32, wherein the step of coupling to the patient a vibration sensing means further comprises coupling said means near a tracheal segment of the patient.

38. The method of claim 32, wherein the step of coupling a position sensing means to the patient further comprises coupling an accelerometer.

39. The method of claim 32, wherein the step of coupling a position sensing means to the patient further comprises coupling to a portion of the patient's body a gravity sensing device having at least one axis of orientation with respect to gravity such that the gravity sensing device occupies different states depending upon which end of the axis is closer to the source of gravity.

40. The method of claim 39, wherein the gravity sensing device is coupled to an axial portion of the patient's body with the axis of orientation of the gravity sensing device at an angle to the axial portion such that the gravity sensing device provides information indicative of which of two or more positions the axial portion of the patient's body is in, one of which positions is substantially supine and one of which positions is not substantially supine.

41. The method of claim 39, wherein step of coupling a position sensing means to the patient further comprises coupling:

a first gravity sensing device having a first axis of orientation with respect to gravity; and
style="padding-left: 40px;">a second gravity sensing device having a second axis of orientation with respect to gravity which can be superpositioned at an angle to the first axis.

42. The method of claim 41, wherein the step of coupling a position sensing means to the patient further comprises coupling the gravity sensing devices to an axial portion of the patient's body with a plane containing the superposition of the two axes at an angle to an axial portion of the patient's body such that the states of the gravity sensing devices provide information indicative of which of two or more positions the axial portion of the patient's body is in.

43. The method of claim 41, wherein the step of coupling a position sensing means to the patient further comprises coupling the gravity sensing devices to an axial portion of the patient's body with the angle between the superposition of the two axes, and the angle between the plane containing the gravity sensing devices and the axial portion of the patient's body, being such that the states of the gravity sensing devices provide information indicative of which of two or more positions the axial portion of the patient's body is in, one of which positions is substantially supine and one of which positions is not substantially supine.

44. The method of claim 41, wherein the step of coupling a position sensing means to the patient further comprises coupling the gravity sensing devices to an axial portion of the patient's body with the angle between the axes of the two gravity sensing devices, and the angle between the plane containing the gravity sensing devices and long axis of the patient's body, being such that the states of the gravity sensing devices provide information indicative of which of three or more positions the axial portion of the patient's body is in, one of which positions is substantially supine, one of which positions is substantially prone, and one of which positions is one or more of the substantially lateral decubitus positions of the patient.

45. The method of claim 41, wherein the step of coupling a position sensing means to the patient further comprises coupling the gravity sensing devices to an axial portion of the patient's body with the angle between the superpositioned axes of the two gravity sensing devices, and the angle between the plane and axial portion of the patient's body, being such that the states of the gravity sensing devices provide information indicative of which of four or more positions the axial portion of the patient's body is in, one of which positions is substantially supine, one of which positions is substantially prone, one of which positions is left lateral decubitus, and one of which positions is right lateral decubitus.

46. The method of claim 41, wherein the step of coupling a position sensing means to the patient further comprises coupling to the patient a housing containing the vibration sensing means and the first and second gravity sensing devices.

47. The method of claim 41, wherein the first gravity sensing device further comprises a tilt switch having:

a body containing a cavity;

a plurality of contact point pairs within the cavity;

an electrically conductive material that is able to move within the cavity, such that as the orientation of the body with respect to gravity changes different pairs of contact points are connected, thus providing a signal indicative of the switch's orientation with respect to gravity..

48. The method of claim 41, wherein the first gravity sensing device is an accelerometer.

49. The method of claim 34, wherein the step of recording data representing the tracheal vibration and orientation information further comprises the steps of:

providing a memory;

converting the tracheal vibration information and information indicative of the orientation of the portion of the patient's body into digital data; and

writing the digital data into the memory.

50. The method of claim 49, wherein the step of providing a memory further comprises providing a non-volatile memory, and further comprises the step of:

coupling the non-volatile memory to the patient such that the patient may be in a state of diminished consciousness without being disturbed during the period of diminished consciousness.

51. The method of claim 49, wherein the step of recording data further comprises the step of:

wirelessly transmitting the tracheal vibration information and information indicative of the orientation of the portion of the patient's body from the sensing means to a recording device containing a memory before the step of converting the data into digital data.

52. The method of claim 49, wherein the step of recording data further comprises the step of:

wirelessly transmitting the digital data to a recording device containing a memory between the steps of converting the information into digital data and the step of writing the digital data into the memory.